Quarterly TSM&O Performance Measurement Report

Broward County

October 2010

Florida DOT District 4
Transportation System
Management & Operations
Program

Table of Contents

Introduction

As congestion continues to increase disproportionately to funding resources, the current practice of roadway expansion is becoming obsolete. It is clear that a paradigm shift is needed, and the Florida Department of Transportation (FDOT) is responding by developing a statewide Transportation System Management and Operations (TSM&O) program that is expected to address the growing congestion problem within the state. TSM&O will shift the focus of FDOT's strategies to ones that provide mobility outcomes, such as travel time reliability, that maximize the efficiency of the transportation system. TSM&O improves mobility for all users through an emphasis on real-time active management and operations of the existing transportation system. TSM&O is a performance driven program that requires inter-agency coordination and collaboration among the agencies that currently manage and/or operate the transportation system.

The Broward County TSM&O program began with the formation of the Broward County TSM&O Task Team. The Task Team is comprised of the agencies that manage and/or operate the Broward County transportation system, which include Broward County Traffic Engineering Division (BCTED), Broward County Transit (BCT), Broward County Metropolitan Planning Organization (MPO), FDOT Planning, FDOT Traffic Operations, and FDOT Modal Development. The Team has been meeting regularly since its formation in January 2009. Activities to date include defining the Broward County TSM&O Initial Deployment Network and targeted user groups; defining performance measures to begin tracking; and establishing a quarterly performance reporting schedule.

This report represents the second quarterly report on TSM&O performance measurement for Broward County. For purposes of comparison, this report references the results of the first quarterly report for Broward County, published in July 2009.

The quarterly performance measurement reports will be used to identify trends and assist FDOT and Broward County in understanding the causal relationship between resources allocated to specific TSM&O activities and the resulting outcomes. It is expected that TSM&O program activities in Broward County will continue to be refined based in part on what is learned through the performance measurement process.

TSM&O Performance Measures

The TSM&O performance measures addressed in this report include the following:

- Mobility Performance Measures
  - Travel Time Index
  - Arterial Travel Time Delay
  - Throughput (Vehicle)
  - Throughput (Person)

- Transit Performance Measures
  - Transit Schedule Adherence
- Safety Performance Measures
  - Number of Incidents
  - Incident Duration
- Other Performance Measures
  - Signal System Health
  - Work Zone Characteristics
  - Air Quality
  - Resources Spent

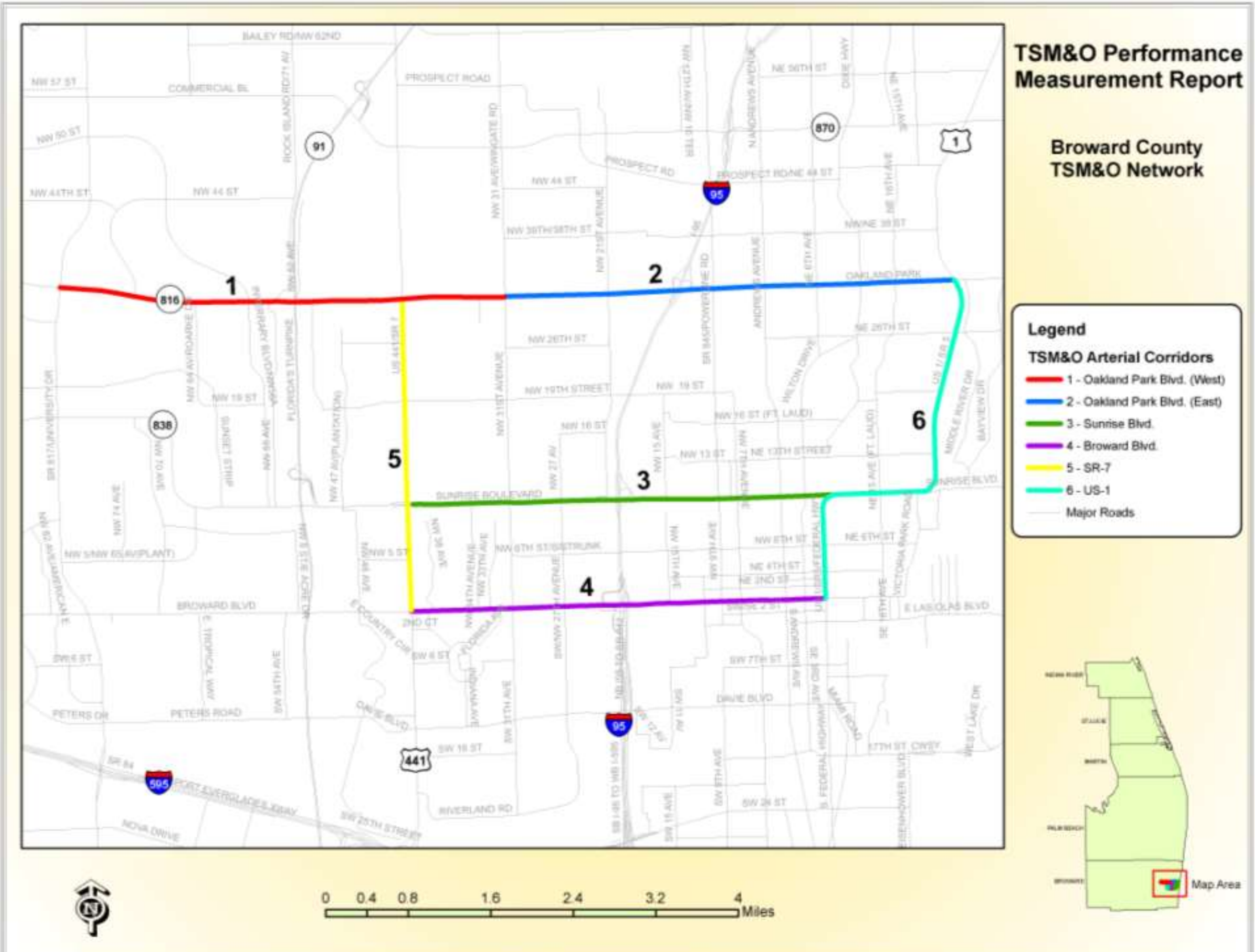
TSM&O NETWORK

Arterial roadways included in the Broward County TSM&O Initial Deployment Network include the following:

1. Oakland Park Boulevard (West) from SR 817/ University Drive to NW 31st Avenue (3.7 mi)
2. Oakland Park Boulevard (East) from NW 31st Avenue to US 1/SR 5 (3.7 mi)
3. Sunrise Boulevard from SR 7/US 441 to US 1/SR 5 (4.1 mi)
4. Broward Boulevard from SR 7/US 441 to US 1/SR 5/Federal Highway (4.0 mi)
5. SR 7/US 441 from Broward Boulevard to Oakland Park Boulevard (3.1 mi)
6. US 1/SR 5 from Broward Boulevard to Oakland Park Boulevard (4.1 mi)

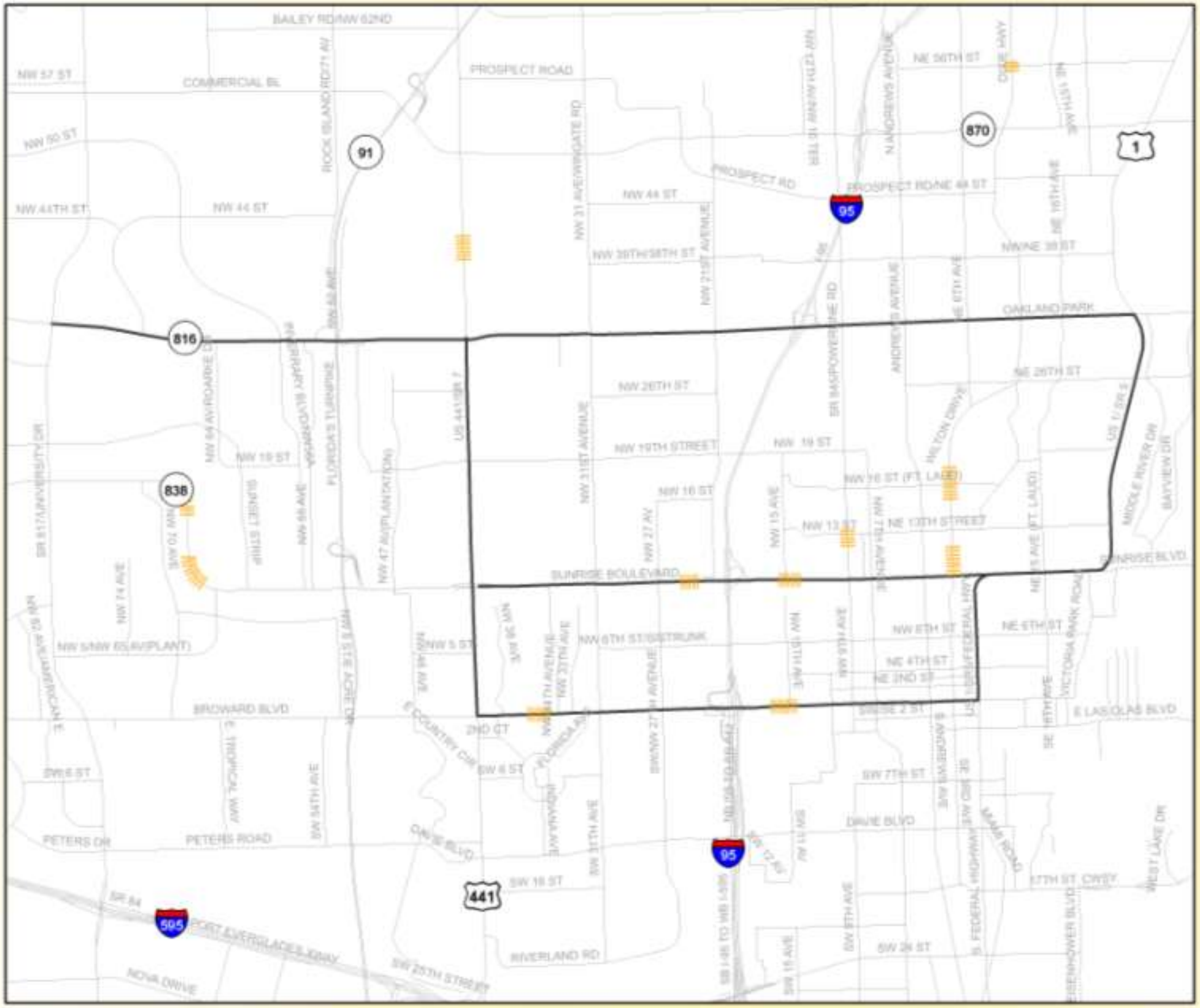
School zones are located along portions of Sunrise Boulevard and Broward Boulevard.

Maps depicting the Broward County TSM&O arterial network and locations of school zones are shown on the following two pages.


TSM&O Performance Measurement Report
Broward County TSM&O Network
Legend
TSM&O Arterial Corridors
1 - Oakland Park Blvd. (West)
2 - Oakland Park Blvd. (East)
3 - Sunrise Blvd.
4 - Broward Blvd.
5 - SR-7
6 - US-1
Major Roads
1
2
3
4
5
6
0 0.4 0.8 1.6 2.4 3.2 4
Miles
Map Area
BAILEY RD/NW 62ND
PROSPECT ROAD
COMMERCIAL BL
SUNRISE BOULEVARD
BROWARD BLVD
PETERS ROAD
DAVIE BLVD
OAKLAND PARK
816
838
91
870
95
595
441

TSM&O Performance Measurement Report

Broward County School Zones



Legend

- School Zones
- TSM&O Arterials
- Major Roads

0 0.4 0.8 1.6 2.4 3.2 4 Miles

Travel Time Index

DEFINITION

The Travel Time Index (TTI) is a measure of congestion that describes the average time it takes to travel during peak hours compared to free flow conditions.

PURPOSE

Report a qualitative measure of the variability or uncertainty in the performance of the TSM&O network over time.

OBJECTIVE

Achieve peak period travel time reliability on critical arterial segments in the TSM&O network.

METHODOLOGY

The TTI is calculated as the ratio of average peak travel time to an off-peak (free-flow) standard, as shown in the following equation:

$$\textbf{Travel Time Index} = \frac{\text{Average Travel Time}}{\text{Free Flow Travel Time}}$$

TTI is reported as an index value. For example, a TTI value of 1.20 means that average peak travel times are 20 percent longer than off-peak travel times. A TTI value equal to or slightly greater than 1 is desired, but may not be realistic for the traffic demands.

TTI is calculated based on travel time data, which are collected by probe vehicles equipped with QSTARZ GPS loggers that record travel time directly while conducting travel time runs along each arterial in the TSM&O network. Travel time runs were conducted on October 14-15, 2009 during the following time periods:

AM peak: from 7 a.m. to 9 a.m.
Midday peak: from 11:30 a.m. to 1:30 p.m.
PM peak: 4 p.m. to 6 p.m.

For purposes of TSM&O performance reporting, the free flow travel time is assumed to be equal to the lowest recorded travel time on the segment of interest (presumed to be the free flow travel time during the off peak period).

RESULTS & TRENDS

Table 1 summarizes the travel time and travel time index results for the Broward County TSM&O network. The table indicates the free flow travel time, average peak period travel time, travel time index, and change compared to previous quarter values. The TTI values highlighted

in red indicate the worst congested arterials for each peak period, as well as the arterials experiencing the greatest increase and decrease compared to last quarter. Figure 1 shows the average travel time for each peak period compared to the free flow travel time, while Figure 2 shows the change in travel time index compared to last quarter.

During the AM peak, the eastbound direction of Broward Boulevard experienced the most congestion, with a travel time index of 1.89. This is a 10.5 percent increase compared to last quarter. The eastbound direction of Oakland Park Boulevard (West) experienced the greatest increase (41.4 percent) compared to last quarter, while the southbound direction of SR 7 experienced the greatest decrease (31.0 percent). During the midday peak, the northbound direction of US 1 experienced the most congestion, with a travel time index of 1.99. This corridor also experienced the greatest increase (33.0 percent) compared to last quarter. The southbound direction of SR 7 experienced the greatest decrease (27.8 percent). During the PM peak, the westbound direction of Oakland Park Boulevard (East) experienced the most congestion, with a travel time index of 2.19. This corridor also experienced the greatest increase (43.4 percent) compared to last quarter. The northbound direction of SR 7 experienced the greatest decrease (23.5%).

Table 1. Travel Time Index for the TSM&O Network

ID	Arterial Corridor	Dir	Free Flow TT	AM Peak Period			Midday Peak Period			PM Peak Period		
				Average TT	TTI	Change from Last Quarter	Average TT	TTI	Change from Last Quarter	Average TT	TTI	Change from Last Quarter
1	Oakland Park Blvd (West)	EB	07:00	12:16	**1.75**	+41.4%	09:38	**1.38**	-4.4%	13:40	**1.95**	+79.1%
		WB	07:00	09:23	**1.34**	+6.4%	09:05	**1.30**	-2.5%	09:48	**1.40**	-8.5%
2	Oakland Park Blvd (East)	EB	09:08	11:03	**1.21**	-2.5%	12:51	**1.41**	-2.3%	13:31	**1.48**	+35.7%
		WB	08:52	10:51	**1.22**	-2.9%	11:29	**1.30**	-2.6%	19:27	**2.19**	+43.4%
3	Sunrise Blvd	EB	11:08	15:39	**1.41**	+6.5%	12:54	**1.16**	-21.2%	14:17	**1.28**	-16.1%
		WB	10:32	13:31	**1.28**	-9.0%	12:13	**1.16**	-17.7%	13:40	**1.30**	-18.9%
4	Broward Blvd	EB	7:12	13:36	**1.89**	+10.5%	10:34	**1.47**	-0.1%	11:29	**1.60**	+13.9%
		WB	8:11	10:46	**1.32**	+18.5%	10:14	**1.25**	+1.6%	14:22	**1.76**	+22.8%
5	SR 7	NB	06:00	08:08	**1.36**	-2.5%	7:22	**1.23**	-22.2%	9:49	**1.64**	-23.5%
		SB	07:36	07:46	**1.02**	-31.0%	8:47	**1.16**	-27.8%	10:00	**1.32**	-16.2%
6	US 1	NB	07:04	9:21	**1.32**	+1.8%	14:06	**1.99**	+33.0%	11:42	**1.65**	+8.9%
		SB	07:20	08:55	**1.21**	+7.5%	9:24	**1.28**	-5.8%	10:46	**1.47**	+6.4%

Figure 1. Average Travel Time on the TSM&O Network

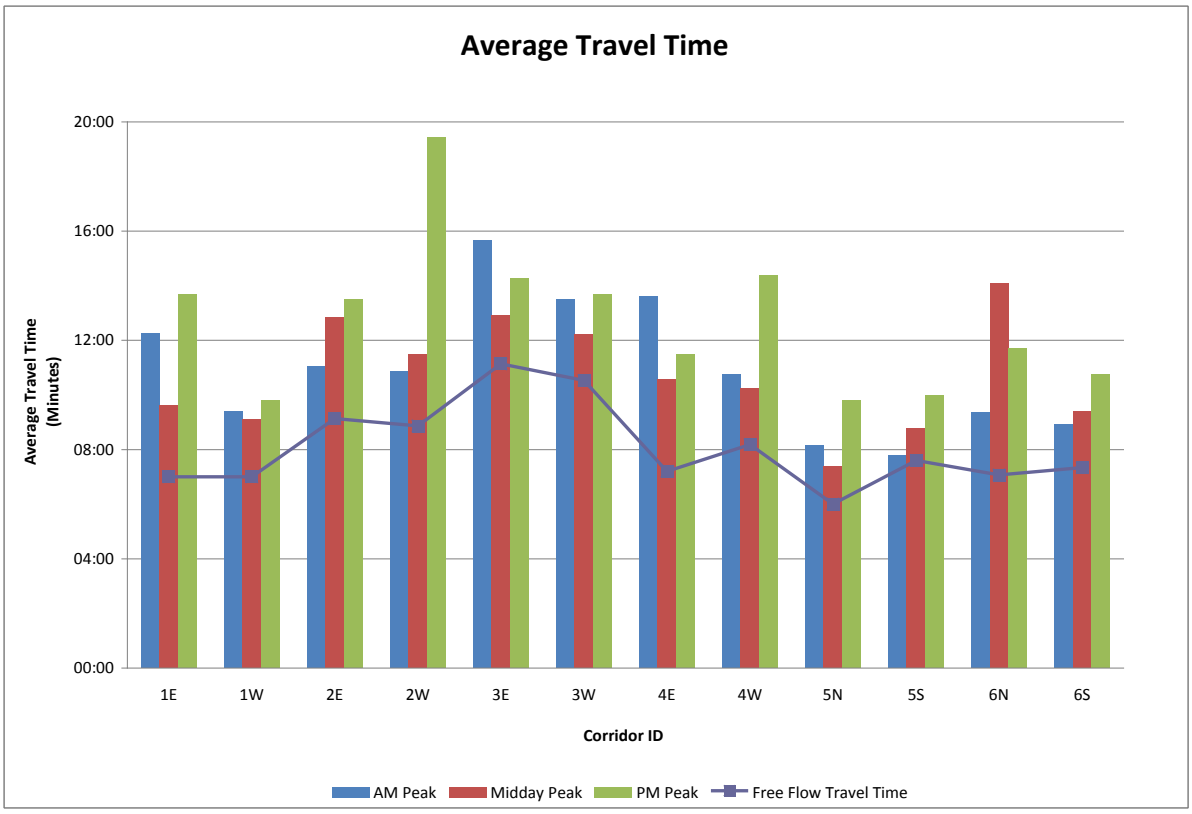


Figure 2. Travel Time Index - Change from Last Quarter

Arterial Travel Time Delay

DEFINITION

Arterial travel time delay is the additional travel time beyond the "ideal" (or free flow) travel time experienced by a driver along a corridor. Stopped and control delay are inherently included as part of this measure, since its calculation is based on cumulative travel time runs conducted between the begin and end points of the corridor.

PURPOSE

Report a qualitative measure of arterial travel time delay on the TSM&O network over time.

OBJECTIVE

Reduce delay on critical arterial segments in the TSM&O network.

METHODOLOGY

Average travel time delay is calculated as the difference between the average travel time measured during the peak period, and the free flow travel time, as shown in the following equation:

Average Arterial Travel Time Delay = Average Travel Time – Free Flow Travel Time

Average travel time delay is calculated based on travel time data obtained from the travel time runs conducted along each arterial in the TSM&O network, as described in the previous section. The average travel time was computed by direction for each corridor and peak period. For purposes of TSM&O performance reporting, the free flow travel time is equal to the lowest recorded travel time for each direction of the corridor across all peak periods (presumed to be the free flow travel time during the off peak period).

RESULTS & TRENDS

Table 2 summarizes the arterial travel time delay results for each arterial in the Broward County TSM&O network. The values highlighted in red indicate the arterial with the highest average arterial travel time delay for each time period, as well as the arterials experiencing the greatest increase and decrease compared to last quarter. Figure 3 shows the average arterial travel time delay for each peak period, while Figure 4 shows the change in arterial travel time delay compared to last quarter.

During the AM peak, the eastbound direction of Broward Boulevard experiences the highest delay, with an average of 6 minutes 24 seconds. This is a slight increase (1 minute 22 seconds) compared to last quarter. The northbound direction of US 1 experiences the highest delay during the midday peak, with an average delay of 7 minutes 2 seconds. This is an increase of 3 minutes compared to last quarter. The westbound direction of Oakland Park Boulevard (East)

experiences the highest delay during the PM peak, with an average delay of 10 minutes 35 seconds. This is an increase of 2 minutes compared to last quarter.

Table 2. Arterial Travel Time Delay for the TSM&O Network

ID	Arterial Corridor	Dir	AM Peak Period		Midday Peak Period		PM Peak Period	
			Average Delay	Change from Last Quarter	Average Delay	Change from Last Quarter	Average Delay	Change from Last Quarter
1	Oakland Park Blvd (West)	EB	5:16	+1:07	**2:38**	-5:06	**6:40**	+5:04
		WB	2:23	-1:53	2:05	-3:12	**2:48**	-5:48
2	Oakland Park Blvd (East)	EB	1:54	-2:15	3:43	-4:01	4:23	+2:47
		WB	1:59	-2:17	2:37	-2:40	**10:35**	+1:59
3	Sunrise Blvd	EB	**4:31**	+1:42	1:45	-2:26	3:09	-1:34
		WB	2:59	-0:45	1:41	-2:04	3:08	-2:21
4	Broward Blvd	EB	**6:24**	+1:22	3:22	+0:03	4:17	+1:28
		WB	2:35	+1:38	2:03	-0:01	6:11	+2:18
5	SR 7	NB	2:08	+0:08	1:22	-1:34	3:49	-2:00
		SB	**0:10**	-2:22	1:11	-2:00	2:24	-0:37
6	US 1	NB	2:17	-0:10	**7:02**	+3:28	4:38	+0:57
		SB	1:35	+0:39	2:04	-0:34	3:26	+0:41

Figure 3. Arterial Travel Time Delay for the TSM&O Network

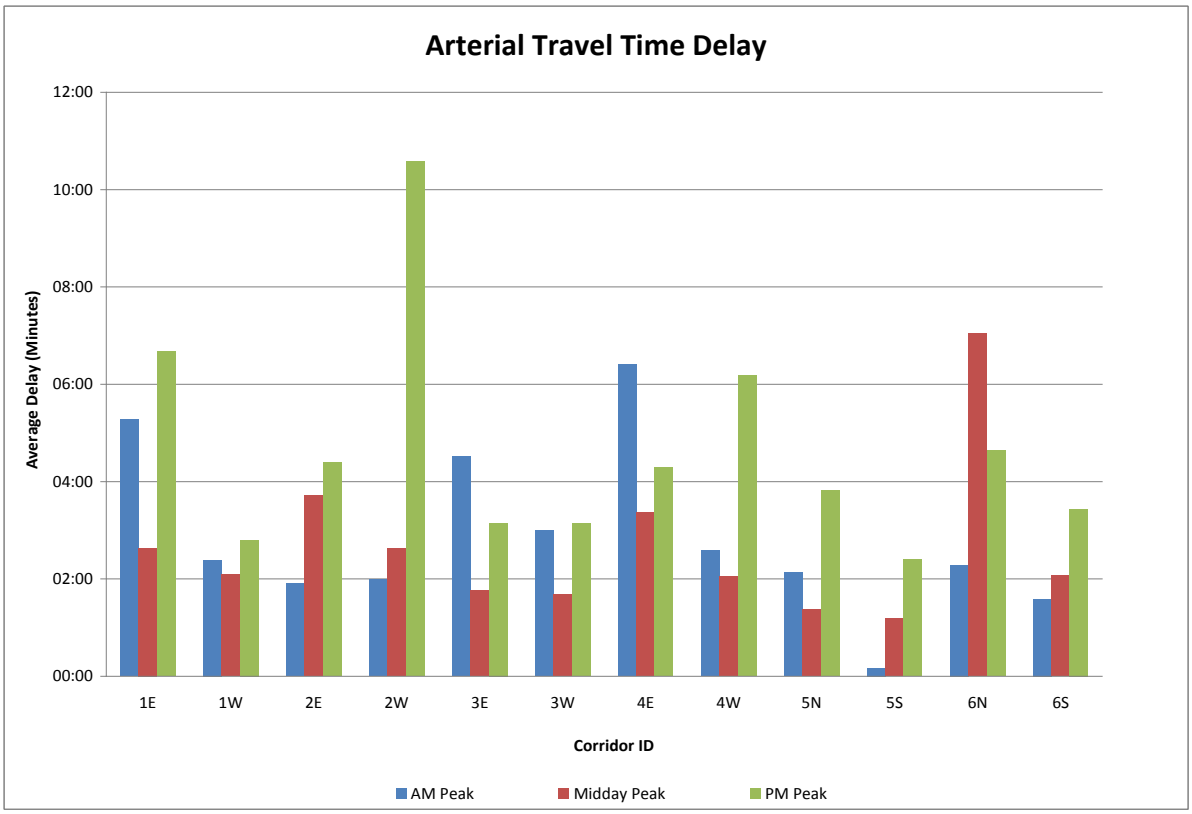
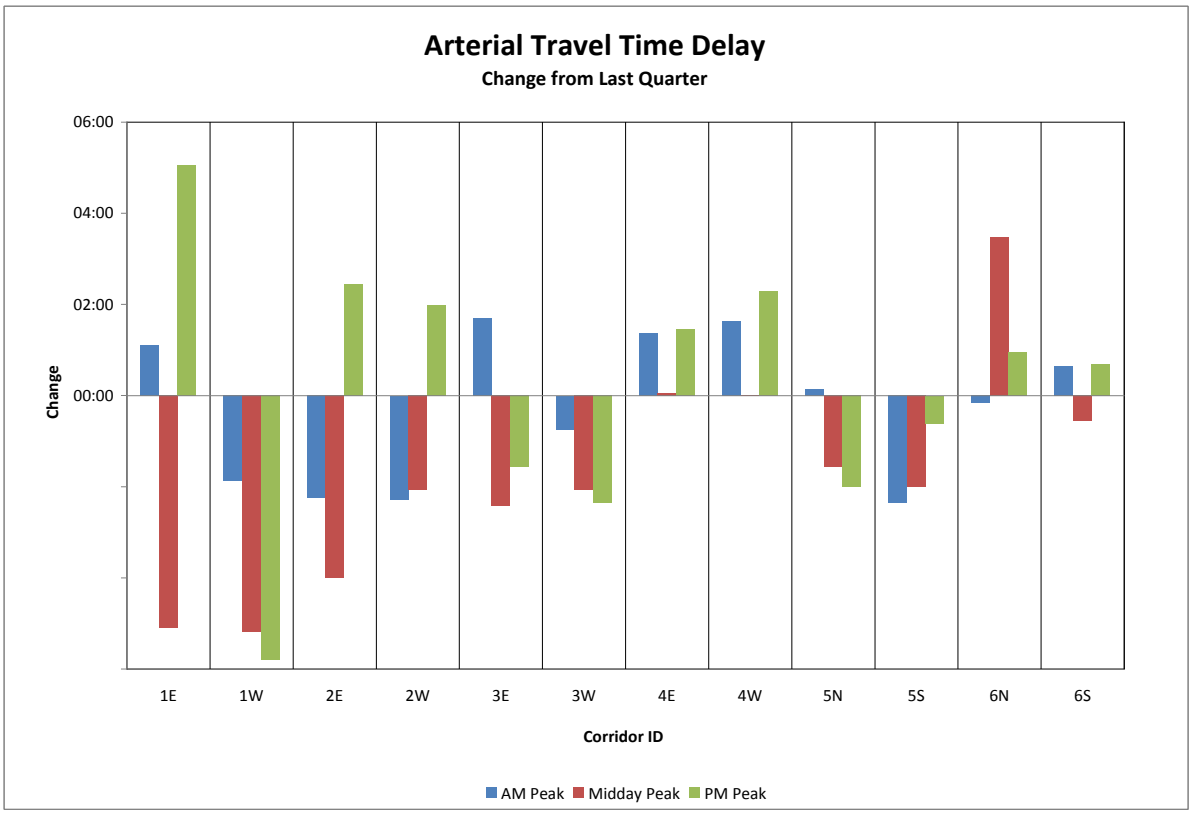


Figure 4. Arterial Travel Time Delay - Change from Last Quarter



Throughput (Vehicle)

DEFINITION

Vehicle throughput is defined as the number of vehicles traversing an arterial during a given peak period.

PURPOSE

Vehicle throughput provides information on how effective the TSM&O network is in moving people and goods through the network.

OBJECTIVE

Increase vehicle volume throughput on the TSM&O network.

METHODOLOGY

Vehicle throughput is calculated based on 24-hour traffic volume counts conducted at 20 Portable Traffic Monitoring Sites (PTMS) located within the TSM&O network, as shown on the map on the following page. The locations in blue depict sites that are maintained by Florida DOT, while the locations in green depict those maintained by the local jurisdiction. Each PTMS location is equipped with in-pavement sensors (loops and/or piezoelectric traffic sensors) and a traffic cabinet. A traffic counter is placed in the cabinet and attached to the in-pavement sensors to collect vehicle volume data for the duration of the data collection period.

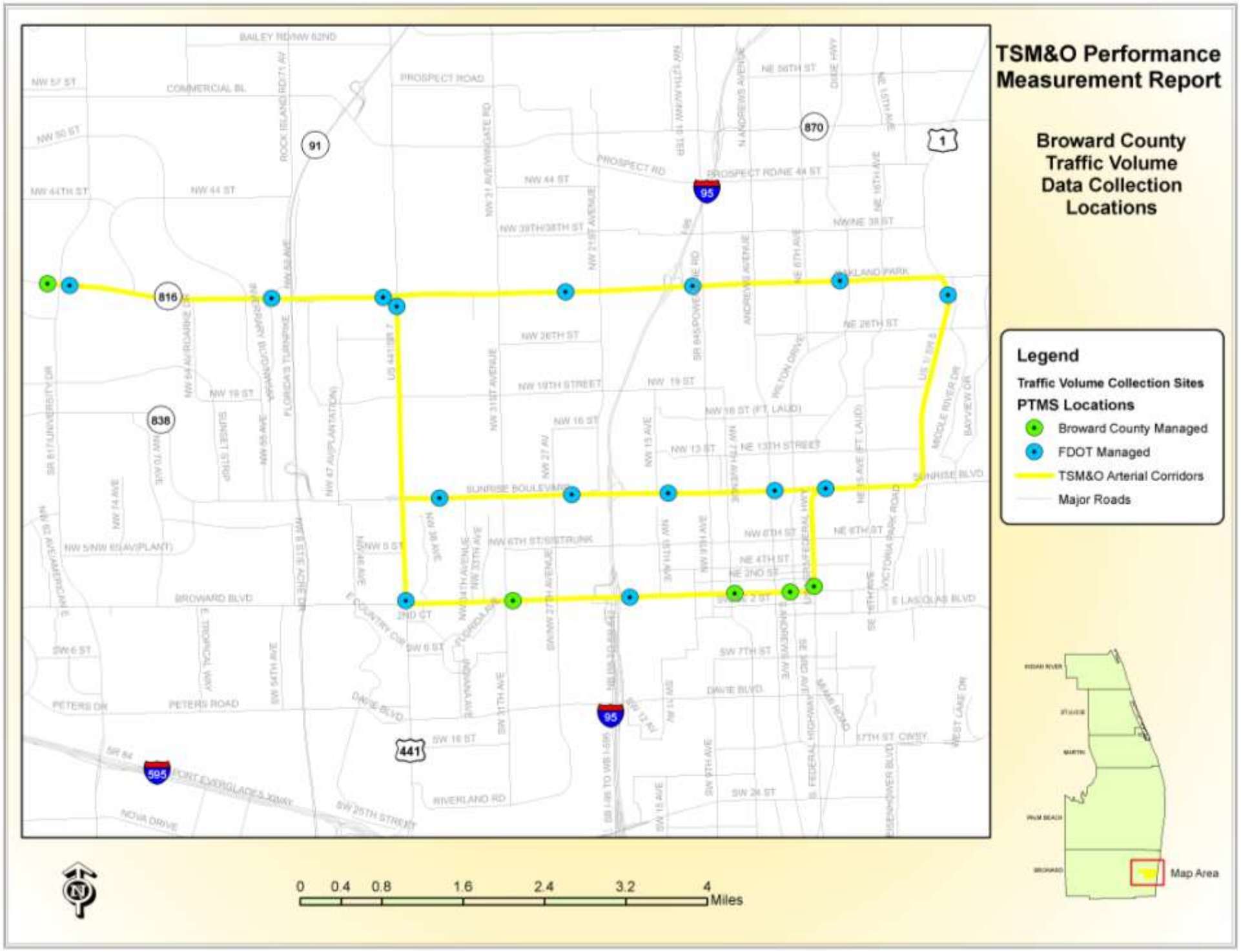
Traffic volume data were collected at each PTMS location in 15-minute increments by lane for the period from October 14-15, 2009. The volumes across all lanes was computed for each hour of each day of data collection. An average hourly volume was then computed for each peak period, defined as follows:

AM peak: from 7 a.m. to 9 a.m.
Midday peak: from 11:30 a.m. to 1:30 p.m.
PM peak: 4 p.m. to 6 p.m.

The average hourly volume was then computed across all PTMS locations for each arterial corridor.

RESULTS & TRENDS

Table 3 summarizes the vehicle throughput results for the Broward County TSM&O network. The values highlighted in red indicate the arterial corridors with the greatest change in vehicle throughput compared to the previous quarter for each time period. Figure 5 shows the average hourly vehicle throughput for each peak period, while Figure 6 shows the change in vehicle throughput compared to last quarter.


TSM&O Performance Measurement Report
Broward County Traffic Volume Data Collection Locations
Legend
Traffic Volume Collection Sites
PTMS Locations
Broward County Managed
FDOT Managed
TSM&O Arterial Corridors
Major Roads
0 0.4 0.8 1.6 2.4 3.2 4 Miles
Map Area
BAILEY RD/NW 62ND
COMMERCIAL BL
PROSPECT ROAD
PROSPECT RD/NE 44 ST
NW 44 ST
NW 39TH/38TH ST
NW 26TH ST
NW 19TH STREET
NW 19 ST
NW 16 ST (FT. LAUD)
NW 16 ST
NW 13 ST
NE 13TH STREET
SUNRISE BOULEVARD
NW 6TH ST/SISTRUNK
NE 6TH ST
NE 4TH ST
NE 2ND ST
BROWARD BLVD
2ND CT
SW 6 ST
SW 7TH ST
DAVIE BLVD
PETERS DR
PETERS ROAD
SW 16 ST
RIVERLAND RD
SW 26TH STREET
NOVA DRIVE
SR 84
PORT EVERGLADES XWAY
E LAS OLAS BLVD
SUNRISE BLVD
OAKLAND PARK
91
870
1
95
816
838
441
595

During the AM peak, the eastbound direction of Sunrise Boulevard had an average vehicle throughput of 1,927 vehicles per hour, which is an 18 percent increase compared to last quarter. This corridor also had the greatest change during the midday peak period, with an average of 1,508 vehicles per hour and 8.3 percent increase compared to last quarter. During the PM peak, the northbound direction of US 1 had an average vehicle throughput of 1,956 vehicles per hour, which is an increase of 13.5 percent compared to last quarter.

Table 3. Vehicle Throughput for the TSM&O Network

ID	Arterial Corridor	Dir	AM Peak Period		Midday Peak Period		PM Peak Period	
			Average Hourly Volume	Change from Last Quarter	Average Hourly Volume	Change from Last Quarter	Average Hourly Volume	Change from Last Quarter
1	Oakland Park Blvd (West)	EB	2,122	17.2%	1,520	**-5.9%**	1,806	4.2%
		WB	1,489	16.5%	1,510	-4.7%	2,046	0.7%
2	Oakland Park Blvd (East)	EB	1,804	16.5%	1,656	2.8%	1,683	-2.8%
		WB	1,406	11.6%	1,651	4.2%	1,880	**-8.1%**
3	Sunrise Blvd	EB	1,927	**18.3%**	1,508	**8.3%**	1,688	5.3%
		WB	1,169	10.0%	1,571	8.0%	1,977	3.5%
4	Broward Blvd	EB	2,014	**-1.9%**	1,589	6.6%	1,554	4.5%
		WB	1,165	3.0%	1,448	-2.4%	2,123	1.7%
5	SR 7	NB	1,446	6.9%	1,439	-2.7%	1,768	0.4%
		SB	1,463	9.8%	1,540	-5.0%	1,817	-5.8%
6	US 1	NB	1,080	5.1%	1,617	6.9%	1,956	**13.5%**
		SB	1,533	14.6%	1,579	5.6%	1,708	4.8%

Figure 5. Vehicle Throughput for the TSM&O Network

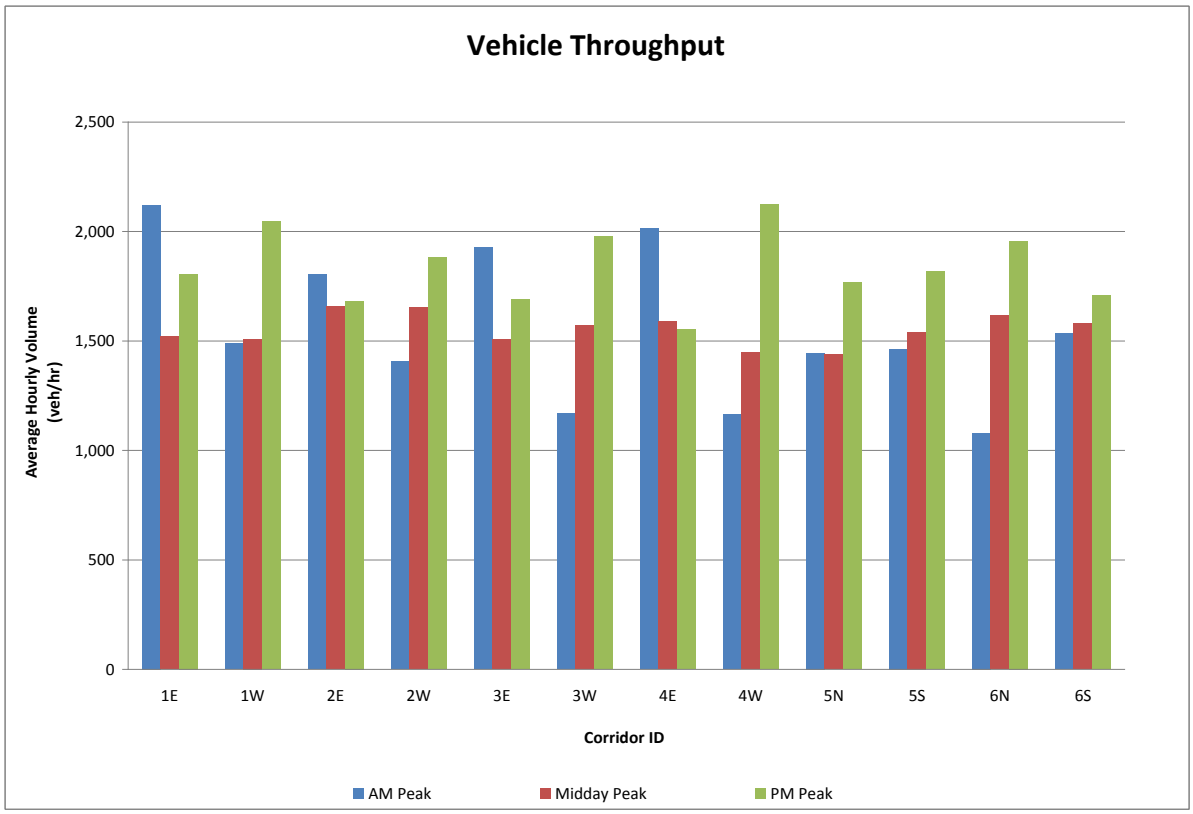
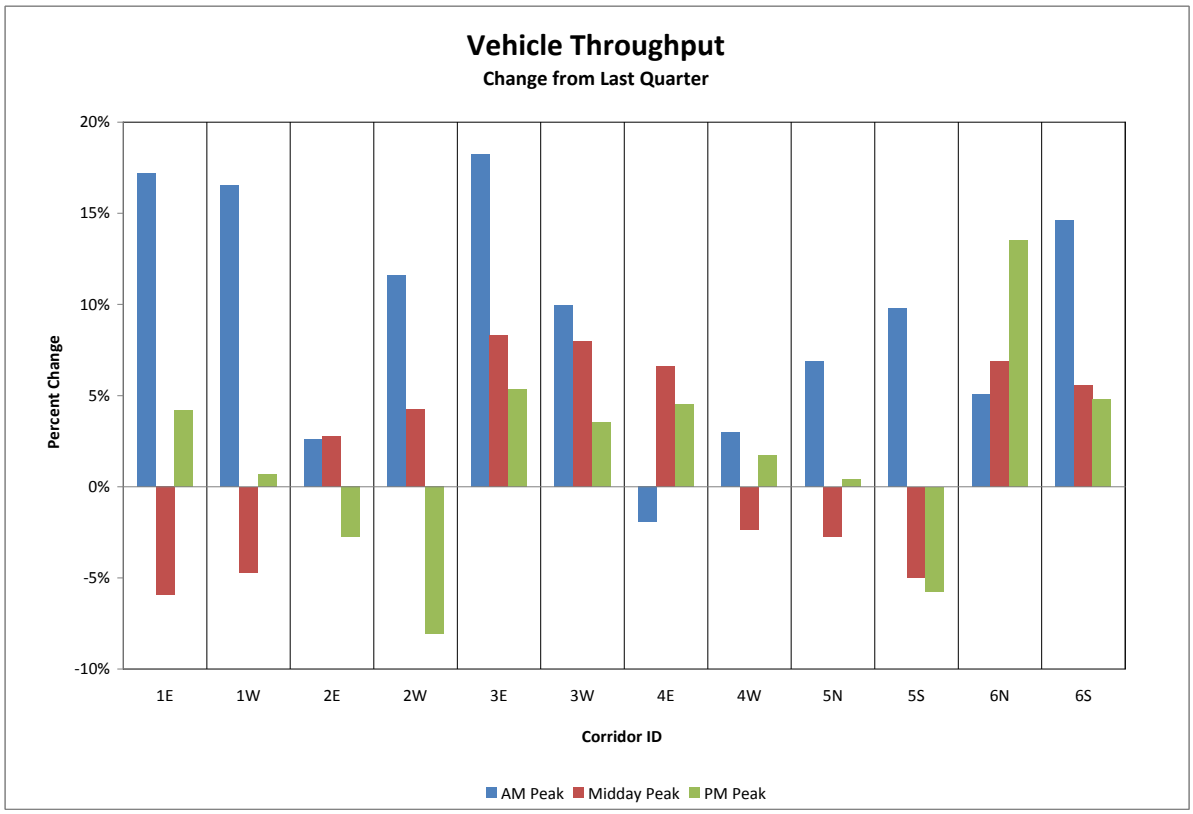
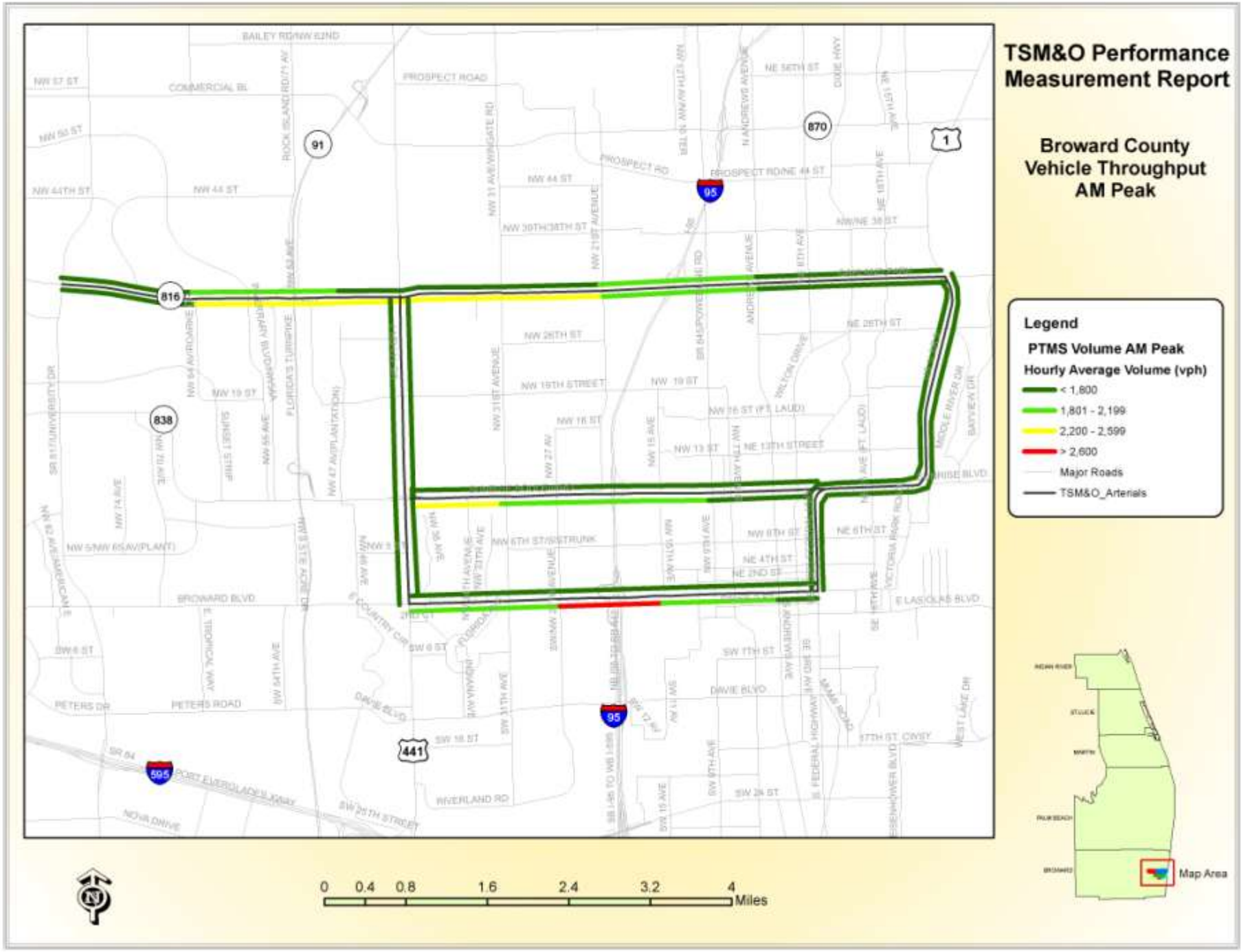
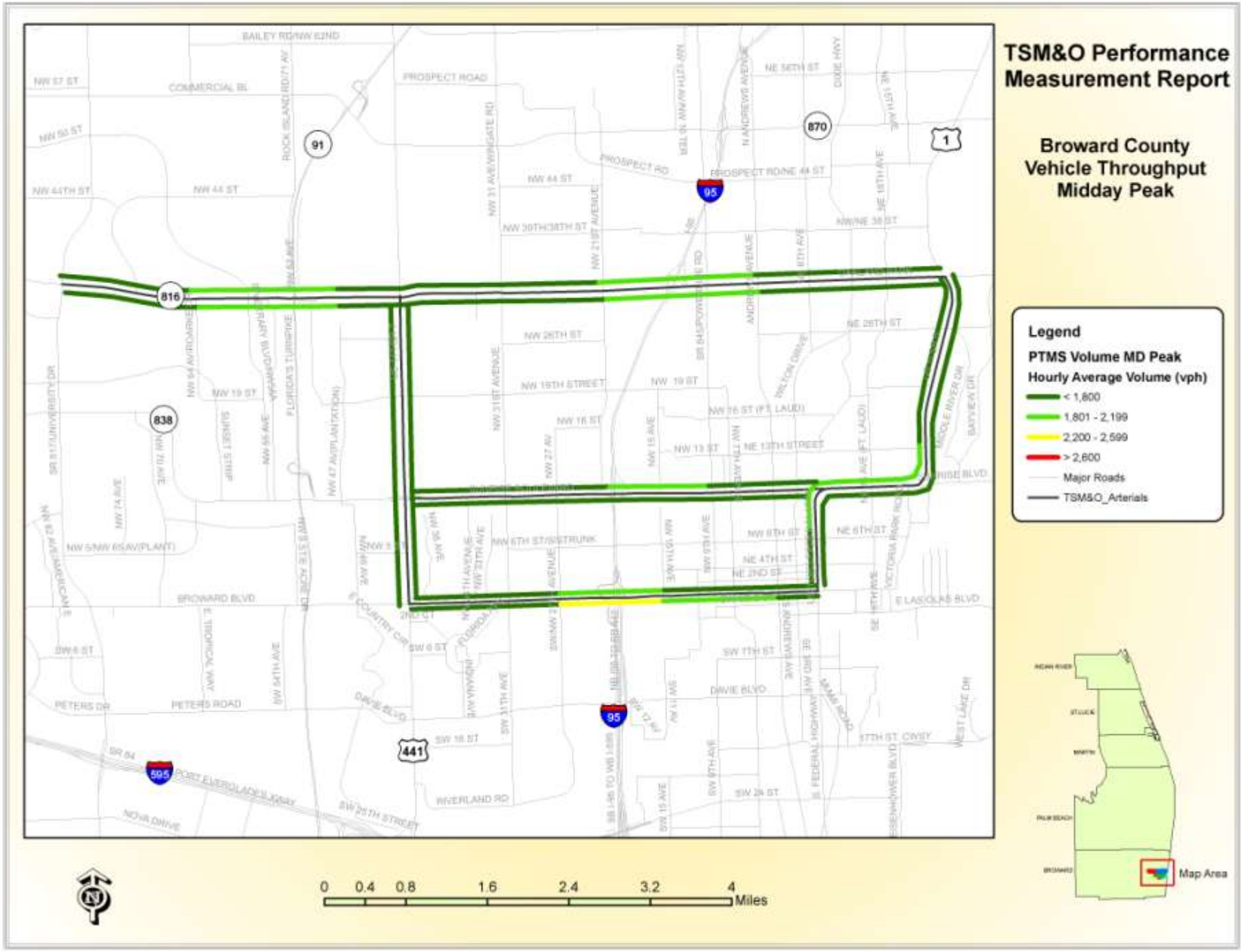
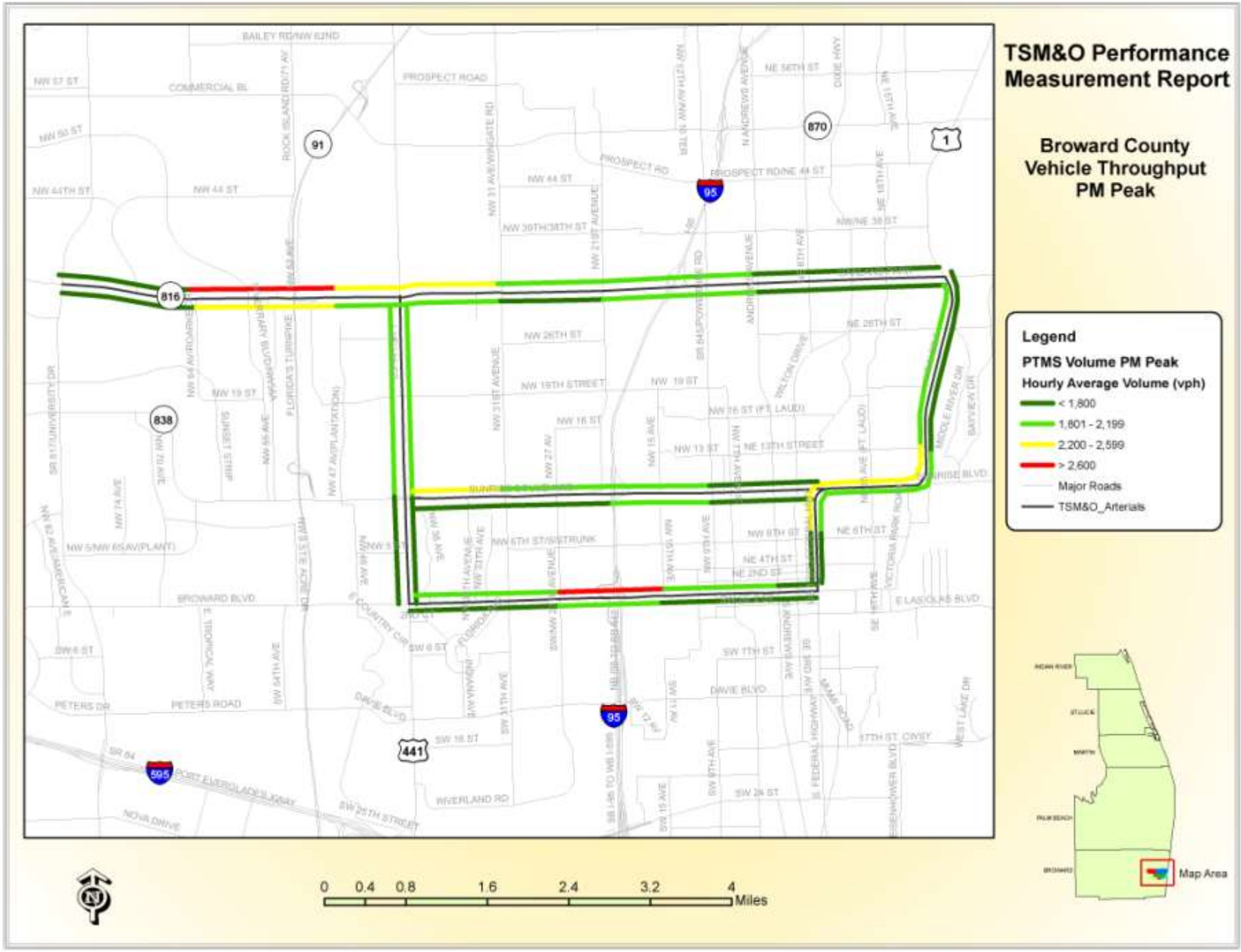


Figure 6. Vehicle Throughput - Change from Last Quarter




TSM&O Performance Measurement Report
Broward County Vehicle Throughput AM Peak
Legend
PTMS Volume AM Peak
Hourly Average Volume (vph)
< 1,800
1,801 - 2,199
2,200 - 2,599
> 2,600
Major Roads
TSM&O_Arterials
0 0.4 0.8 1.6 2.4 3.2 4
Miles
Map Area


TSM&O Performance Measurement Report
Broward County Vehicle Throughput Midday Peak
Legend
PTMS Volume MD Peak
Hourly Average Volume (vph)
< 1,600
1,801 - 2,199
2,200 - 2,599
> 2,600
Major Roads
TSM&O_Arterials
Map Area
0 0.4 0.8 1.6 2.4 3.2 4
Miles


TSM&O Performance Measurement Report
Broward County Vehicle Throughput PM Peak
Legend
PTMS Volume PM Peak
Hourly Average Volume (vph)
< 1,800
1,801 - 2,199
2,200 - 2,599
> 2,600
Major Roads
TSM&O_Arterials
Map Area
0 0.4 0.8 1.6 2.4 3.2 4 Miles
BAILEY RD/NW 62ND
NW 57 ST
COMMERCIAL BL
PROSPECT ROAD
NW 50 ST
NW 44TH ST
NW 44 ST
NW 30TH/38TH ST
NE 56TH ST
NE 44 ST
NE 26TH ST
NW 26TH ST
NW 19TH STREET
NW 19 ST
NW 16 ST (FT. LAUD)
NW 13 ST
NE 13TH STREET
NW 6TH ST/SISTRUNK
NW 8TH ST
NE 6TH ST
NE 4TH ST
NE 2ND ST
BROWARD BLVD
SW 6 ST
SW 7TH ST
DAVIE BLVD
PETERS DR
PETERS ROAD
SW 18 ST
SW 24 ST
RIVERLAND RD
SW 25TH STREET
NOVA DRIVE
E LAS OLAS BLVD
SUNRISE BLVD
17TH ST CSWY
WEST LAKE DR
91
870
1
816
838
95
441
595
SR 84
PORT EVERGLADES Expy

Throughput (Person)

DEFINITION

Person throughput is defined as the average number of persons traversing an arterial during a given peak period.

PURPOSE

Person throughput provides information on how effective the TSM&O network is in moving people and goods through the network.

OBJECTIVE

Increase person throughput on the TSM&O network.

METHODOLOGY

Person throughput data is based on two data sources: 1) Transit passenger counts provided by Broward County Transit (BCT) on routes within the TSM&O network; and 2) average vehicle occupancy rates provided by the Broward County MPO. Transit passenger counts were not available for this quarter; therefore, person throughput for October 2009 was computed by applying an average vehicle occupancy rate of 1.3773 persons per vehicle to the vehicle throughput results reported in the previous section.

RESULTS & TRENDS

Table 4 summarizes the person throughput results for the Broward County TSM&O network. The values highlighted in red indicate the arterial corridors with the greatest change in person throughput compared to the previous quarter. Figure 7 shows the average hourly person throughput for each peak period, while Figure 8 shows the change in person throughput compared to last quarter.

The results are similar to those for vehicle throughput, with the eastbound direction of Sunrise Boulevard experiencing the greatest increase in person throughput during the AM and midday peak periods, and the northbound direction of US 1 experiencing the greatest increase during the PM peak period.

Table 4. Person Throughput for the TSM&O Network

ID	Arterial Corridor	Dir	AM Peak Period		Midday Peak Period		PM Peak Period	
			Average Hourly Throughput	Change from Last Quarter	Average Hourly Throughput	Change from Last Quarter	Average Hourly Throughput	Change from Last Quarter
1	Oakland Park Blvd (West)	EB	2,922	17.2%	2,093	-5.9%	2,487	4.2%
		WB	2,051	16.5%	2,079	-4.7%	2,817	-0.7%
2	Oakland Park Blvd (East)	EB	2,485	2.6%	2,281	2.8%	2,319	-2.8%
		WB	1,936	11.6%	2,274	4.2%	2,589	-8.1%
3	Sunrise Blvd	EB	2,654	18.3%	2,077	8.3%	2,325	5.3%
		WB	1,609	10.0%	2,164	8.0%	2,722	3.5%
4	Broward Blvd	EB	2,774	-1.9%	2,189	6.6%	2,140	4.5%
		WB	1,605	3.0%	1,994	-2.4%	2,925	1.7%
5	SR 7	NB	1,991	6.9%	1,982	-2.7%	2,435	0.4%
		SB	2,015	9.8%	2,121	-5.0%	2,503	-5.8%
6	US 1	NB	1,487	5.1%	2,227	6.9%	2,694	13.5%
		SB	2,112	14.6%	2,175	5.6%	2,353	4.8%

Figure 7. Person Throughput for the TSM&O Network

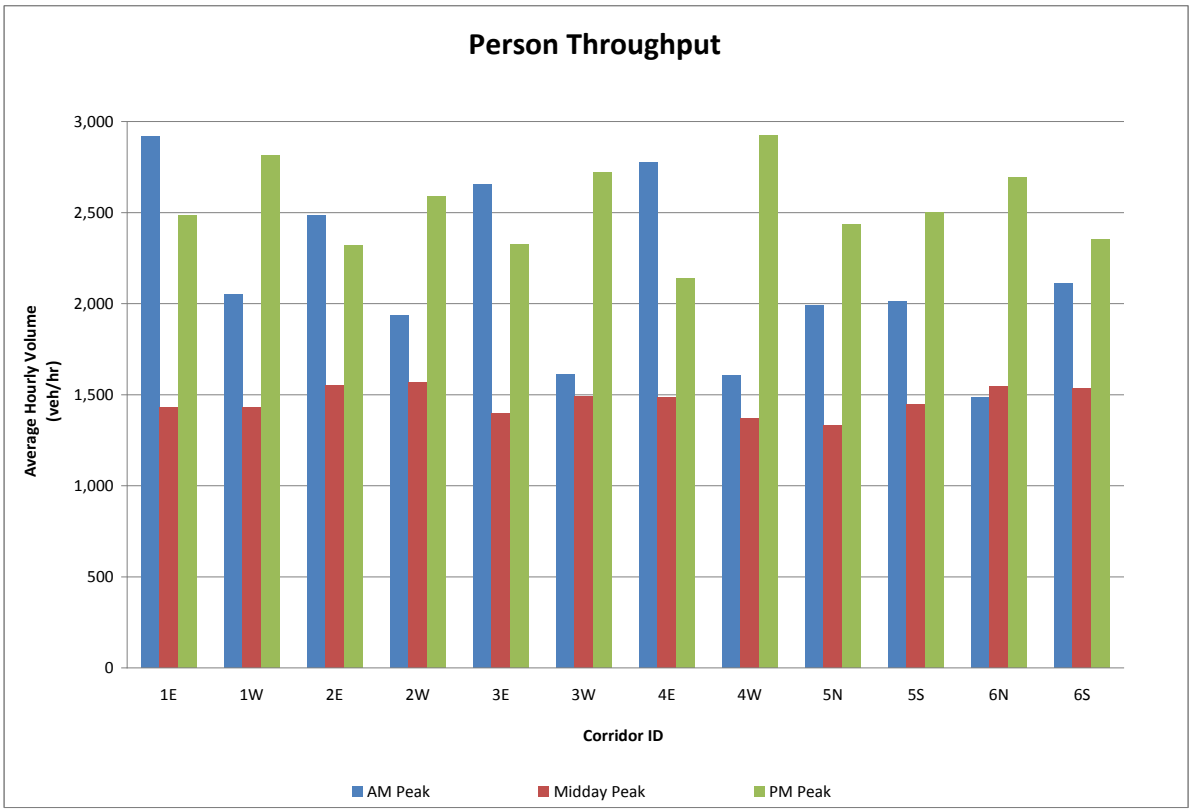
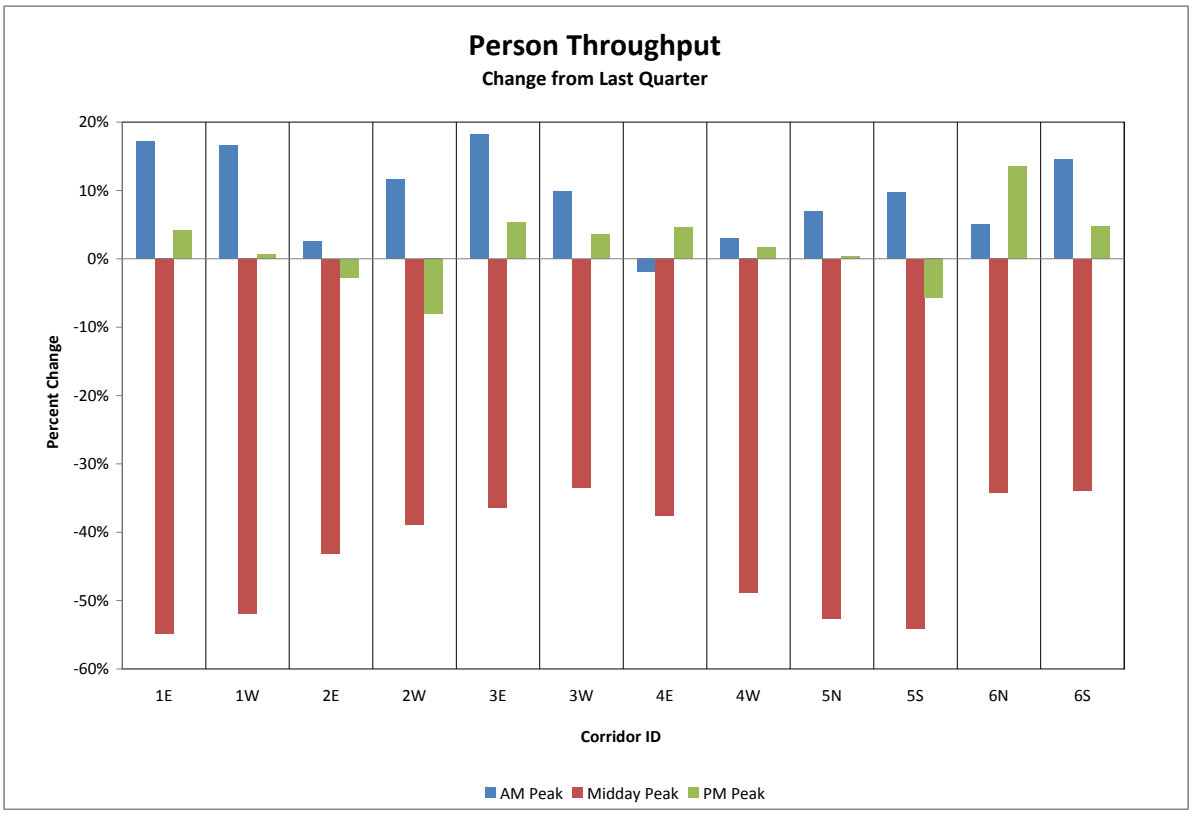


Figure 8. Person Throughput - Change from Last Quarter



Transit Schedule Adherence

DEFINITION

Transit schedule adherence (or on-time performance) is a measure of a bus' ability to adhere to a published schedule. A transit vehicle operating along a fixed route is considered "on-time" if it departs from its scheduled location no more than five (5) minutes early or late.

PURPOSE

Report a qualitative measure of the impact that the TSM&O network has on transit schedule adherence over time.

OBJECTIVE

To track the extent to which fixed route transit vehicles adhere to their pre-determined schedules.

METHODOLOGY

Broward County Transit operates the following local bus routes along the arterials included in the Broward County TSM&O network:

- Route 10 serving US 1
- Route 18 serving SR 7/US 441
- Route 22 serving Broward Boulevard
- Route 36 serving Sunrise Boulevard
- Route 72 serving Oakland Park Boulevard
- Route 441 Breeze serving SR 7/US 441

Transit schedule adherence data for these routes is collected by Broward County Transit (BCT), who runs the report through their Automated Passenger Count (APC) system. BCT is in process of installing an Automatic Vehicle Location (AVL) system, which will be used to report transit schedule adherence when it is operational. FDOT coordinated with BCT to ensure that buses equipped with APC were assigned to the routes within the TSM&O network for the duration of the data collection period.

Data collected includes the number and percent of Very Early Departures (more than 5 minutes early), Early Departures (0 to 5 minutes early), On-time Departures (0 to 5 minutes late), Late Departures (5 to 10 minutes late), and Very Late Departures (more than 10 minutes late). Transit schedule adherence is calculated based on the percent of early and on-time departures (i.e., no more than five minutes early or late). Currently, Broward County Transit has targets

aimed at eliminating *all* early departures. A target for eliminating late departures should be established by the TSM&O Task Team.

RESULTS & TRENDS

Broward County Transit reported ongoing problems with their APC system; therefore, transit schedule adherence data was not available for October 2009. Table 5 summarizes the transit schedule adherence results for last quarter. The values highlighted in red indicate the routes with the worst performance in terms of on-time departure, very early departure, and late/very late departure (for last quarter). Figure 9 shows the transit schedule adherence results graphically for each route.

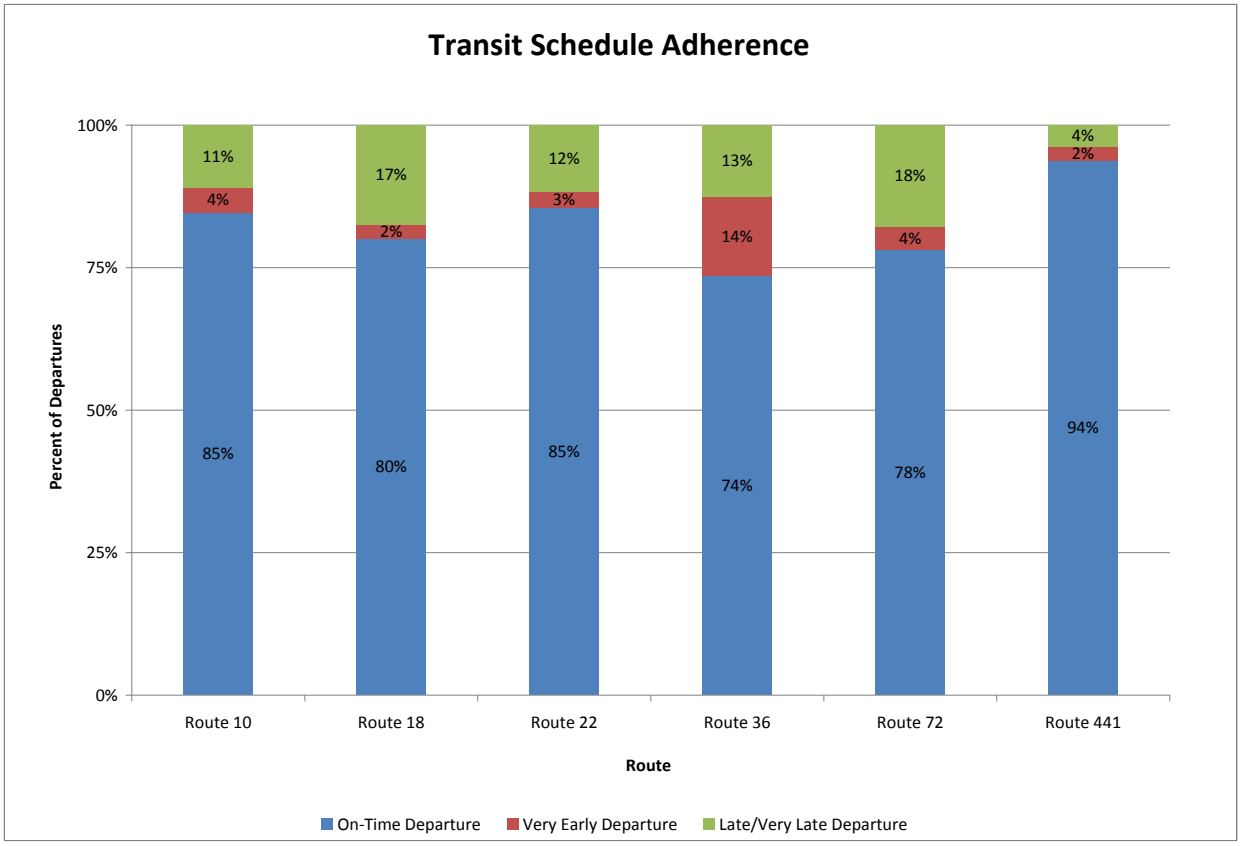
The Route 441 Breeze had the best on-time performance, with 93.9 percent of departures occurring within 5 minutes of the scheduled departure time. Route 36 operating on Sunrise Boulevard had the worst on-time performance, with 73.6 percent. BCT asks that patrons arrive at their bus stop 5 minutes prior to the bus' scheduled arrival; therefore, the very early departures (more than 5 minutes early) should be avoided. However, some routes continue to have very early departures, particularly Route 36 on Sunrise Boulevard, with 13.8 percent of departures occurring more than 5 minutes early. Route 72 on Oakland Park Boulevard had the most late or very late departures, with 17.8 percent of departures occurring more than 5 minutes late.

Table 5. Transit Schedule Adherence for the TSM&O Network

Route	Local Road Served	Percent On Time Departure (Within 5 minutes)		Percent Very Early Departure (More than 5 min early)		Percent Late/Very Late Departure (More than 5 min late)	
		This Quarter*	Last Quarter	This Quarter*	Last Quarter	This Quarter*	Last Quarter
10	US-1	N/A	84.7%	N/A	4.3%	N/A	11.0%
18	SR-7/US-441	N/A	80.1%	N/A	2.5%	N/A	17.4%
22	Broward Boulevard	N/A	85.5%	N/A	2.8%	N/A	11.7%
36	Sunrise Boulevard	N/A	**73.6%**	N/A	**13.8%**	N/A	12.6%
72	Oakland Park Boulevard	N/A	78.1%	N/A	4.0%	N/A	**17.8%**
441	SR-7/US-441	N/A	93.9%	N/A	2.3%	N/A	3.8%
Average		**N/A**	**83.0%**	**N/A**	**4.9%**	**N/A**	**12.1%**

* Transit schedule adherence data not available for October 2009.

Figure 9. Transit Schedule Adherence for the TSM&O Network



Number of Incidents and Incident Duration

DEFINITION

Incident duration is defined as the period of time from when the agency is first notified or observes an incident to the time when the incident is resolved and the arterial travel lanes are cleared.

PURPOSE

Incident duration is included as a performance measure to help identify possible causes of delay on arterials.

OBJECTIVE

Reduce the number and duration of incidents on critical arterial segments in the TSM&O network.

METHODOLOGY

Incident duration data is obtained from the Broward County Sheriff's Office and the City of Fort Lauderdale, as well as travel time run volunteers as they conduct travel time runs along the corridors. Data is also obtained from the SunGuide Transportation Management Center incident logs, as Road Ranger Service Patrol provides service on a portion of Oakland Park Boulevard from University Drive to US 1. This area is monitored during the peak hours of 6 a.m. to 9 a.m. and 4 p.m. to 7 p.m., Monday through Friday.

As part of the travel time data collection effort, volunteers keep a log of incidents observed while they are conducting travel time runs. The start time is recorded as the time they pass by the incident, while the clearance time is recorded as the time they observe the incident has cleared. Incident duration is calculated as the difference between the incident start time and the time the incident is cleared, as shown in the following equation:

Incident Duration = Incident Clearance Time – Incident Start Time

RESULTS & TRENDS

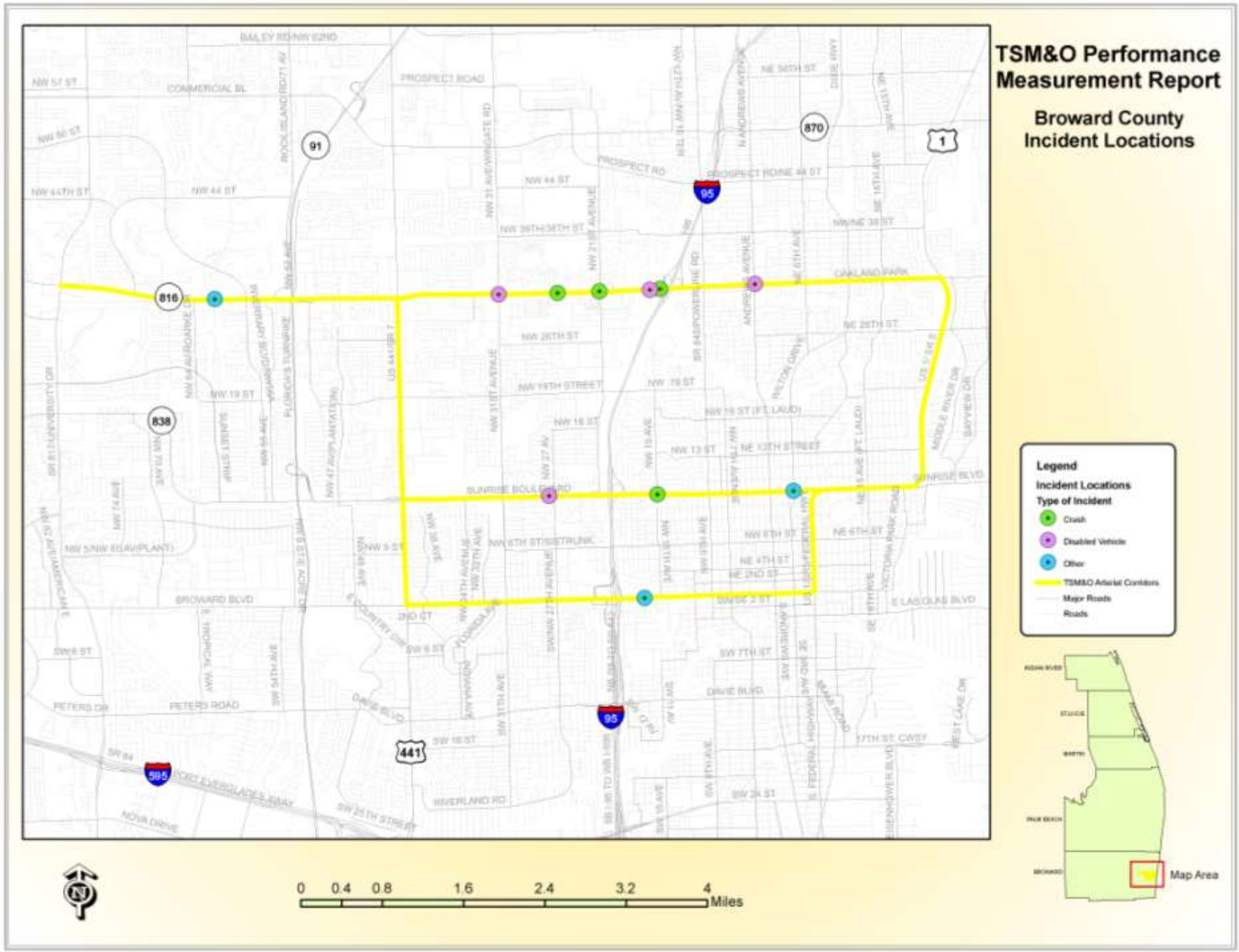
Table 6 summarizes the incident duration results for the Broward County TSM&O network. The values highlighted in red indicate the arterial corridors with the highest incident duration. The location and type of incident are also depicted on the map on the following page.

There were 11 incidents that occurred on the Broward County TSM&O network, with an average incident duration of 13 minutes. This is a significant improvement compared to last quarter's average incident duration of 1 hour and 10 minutes. The incident with the highest duration occurred during the PM peak period on westbound Oakland Park Boulevard (East), just

west of I-95. The incident lasted for 51 minutes and involved a vehicle rollover. As indicated in the results for other performance measures, this corridor also experienced significant increases in travel time index and arterial travel time delay, as well as decreases in vehicle and person throughput during the PM peak period, compared to last quarter. These are likely due to the impact of this incident on the corridor.

Table 6. Incident Duration for the TSM&O Network

ID	Corridor	Location	Type of Incident	Date	Incident Start Time (hr:min)	Incident Clearance Time (hr:min)	Incident Duration (hr:min)	No. of Incidents	Average Incident Duration (min:sec)	Change from Last Quarter (min:sec)
1	Oakland Park Blvd (West)	At NW 60th Ave	Funeral procession (Other)	10/14	12:03	12:06	0:03	2	6:30	-61:30
		At NW 31st Ave	Disabled Vehicle	10/15	17:22	17:32	**0:10**			
2	Oakland Park Blvd (East)	West of I-95	Crash w/vehicle rollover	10/14	16:18	17:09	**0:51**	5	17:24	-71:56
		West of I-95	Disabled Vehicle	10/15	8:57	8:59	0:02			
		east of NW 27th Ave	Crash	10/15	17:16	17:17	0:01			
		At NW 21st Ave	Crash	10/15	17:44	18:08	0:24			
		At N Andrews Ave	Disabled Vehicle	10/15	18:30	18:39	0:09			
3	Sunrise Blvd	West of NW 24 Ave	Disabled 18-wheeler	?	12:25	N/A	N/A	3	19:00	N/A
		At NE 4th Ave	Stalled vehicle	10/15	12:21	12:40	**0:19**			
		At NW 15th Ave	Crash	10/15	18:02	N/A	N/A			
4	Broward Blvd	At Martin Luther King Jr Blvd	Stalled vehicle	10/14	7:09	7:09	0:00	1	0:00	N/A
Total Number of Incidents / Average Incident Duration								**11**	**0:13**	**-57:32**


TSM&O Performance Measurement Report
Broward County Incident Locations
Legend
Incident Locations
Type of Incident
Crash
Disabled Vehicle
Other
TSM&O Arterial Corridors
Major Roads
Roads
Map Area
0 0.4 0.8 1.6 2.4 3.2 4
Miles
816
838
441
595
95
91
870
1

Signal System Health

DEFINITION

Signal system health is defined as the number of signals that went offline or lost communication with the central computer located in the Broward County Traffic Management Center. When a signal falls offline, it essentially loses coordination with adjacent signals on the arterial network, which causes user delay.

PURPOSE

Signal system health provides information on the effectiveness of active signal system operation/management strategies.

OBJECTIVE

Reduce the impact of signal system failures on traffic operations on critical arterial segments in the TSM&O network.

METHODOLOGY

Signal system health is based on traffic signal failure data collected by Broward County Traffic Engineering. This data is routinely collected for all signalized intersections in the county, and includes the date and time of the failure, as well as the type of failure (see Table 7). For all Failure IDs except 0, 10 and 15, it is assumed that communications is lost. For Failure IDs 0, 10 and 15, if the failure is chronic, it could lead to communications failure.

Traffic signal failure data were obtained from Broward County for signalized intersections located along the Broward County TSM&O network. The data were obtained for the period from October 14-15, 2009, then parsed to isolate those signal failures occurring during the peak periods for the network, defined as follows:

AM peak: from 7 a.m. to 9 a.m.
Midday peak: from 11:30 a.m. to 1:30 p.m.
PM peak: 4 p.m. to 6 p.m.

The total number of signal system failures was then computed by peak period for each arterial corridor. These included all signal system failure types except Failure IDs 0, 10 and 15, as described previously. Controller preemption failures (failure ID 60 and 61) are reported separately.

Table 7. Signal System Failure Codes

Failure ID	Description/Cause	Description/Cause
0	Automatic Repair	Every 15 minutes the central computer checks to see if the signals are online and if they are not, it automatically brings them back online.
1	No Communication Response	Central computer sent a command to the signal and the signal did not respond.
10	Controller Stuck	
13	Offset Synchronization Failure	Signal was unable to reach the predefined offset in the allotted amount of time. This can happen when the signal is transitioning between timing patterns.
15	Excessive Clearance Time	
18	Flash	Signal is flashing yellow. Signals are sensitive to changes in voltage, making them vulnerable to lightening and power surges.
50	Maintenance Preemption Finished	Police officer may be manually operating the signal or a technician may be working on the signal.
51	Maintenance Preemption in Progress	
60	Controller Preemption Finished	An emergency vehicle or a train is passing through an intersection causing the signal to turn red for the opposing movements.
61	Controller Preemption In Progress	An emergency vehicle or a train is passing through an intersection causing the signal to turn red for the opposing movements.

RESULTS & TRENDS

Table 8 summarizes the signal system health performance for the Broward County TSM&O Network. The values highlighted in red indicate the arterial corridors with the highest number of signal failures during each peak period. The location and number of signal system failures are also shown on maps for each peak period.

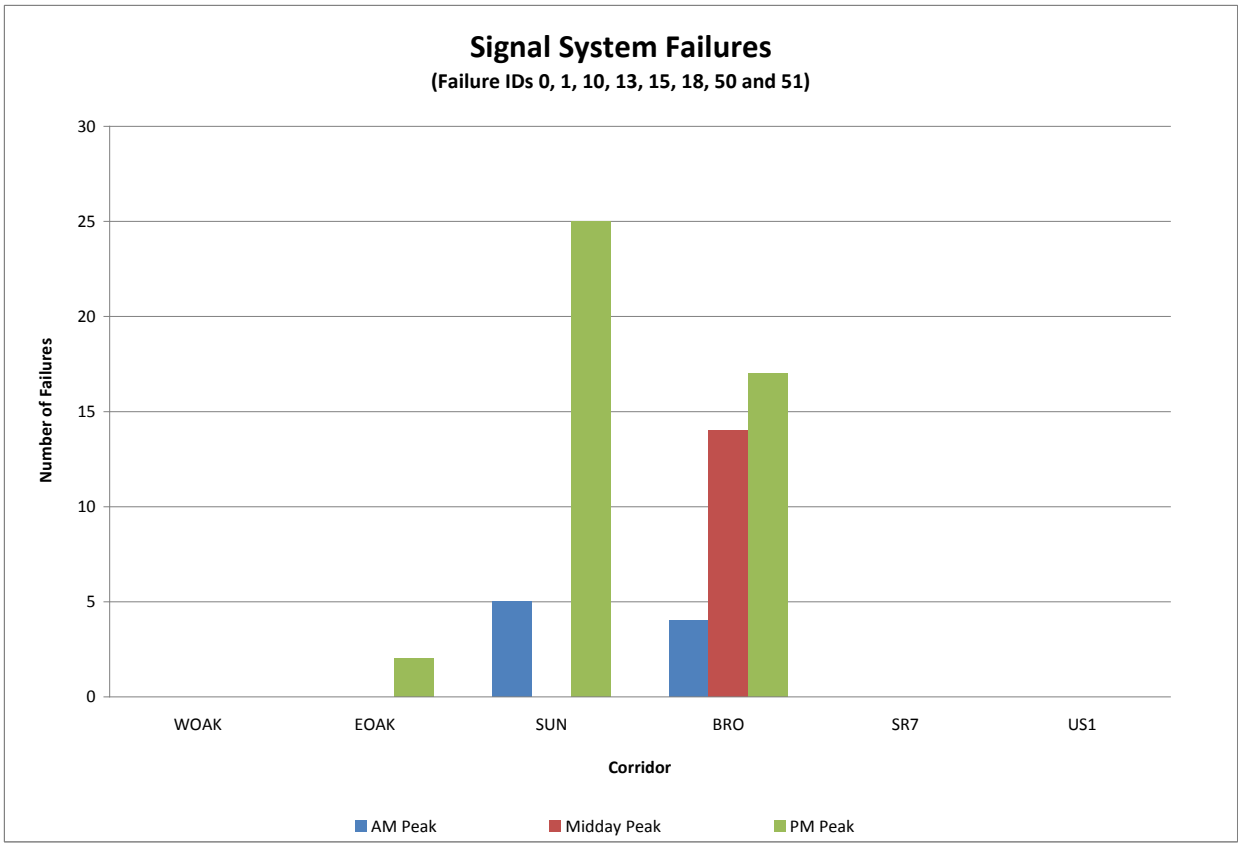
There were 111 signal failures during the AM peak period, with Oakland Park Boulevard (East) experiencing the highest number of failures at 53. During the midday peak, there were 235 total signal failures, with Broward Boulevard experiencing the highest number of failures at 65. During the PM peak, there were 222 total signal failures, with Oakland Park Boulevard (East) again experiencing the highest number of failures at 71.

There were a total of 1,825 traffic signal failures for the entire duration of the data collection period, which is a 25 percent decrease compared to last quarter.

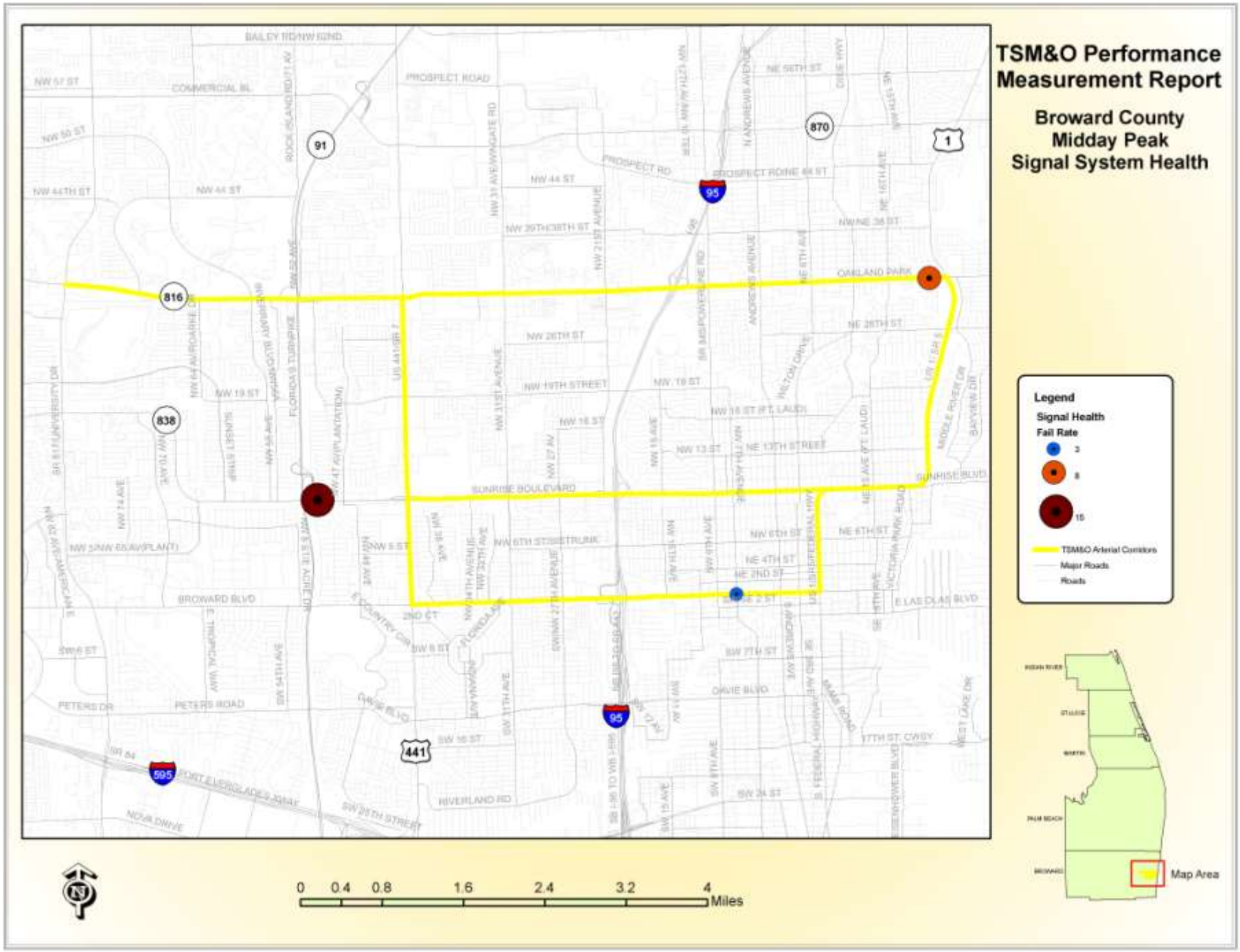
Table 8. Signal System Health for the TSM&O Network

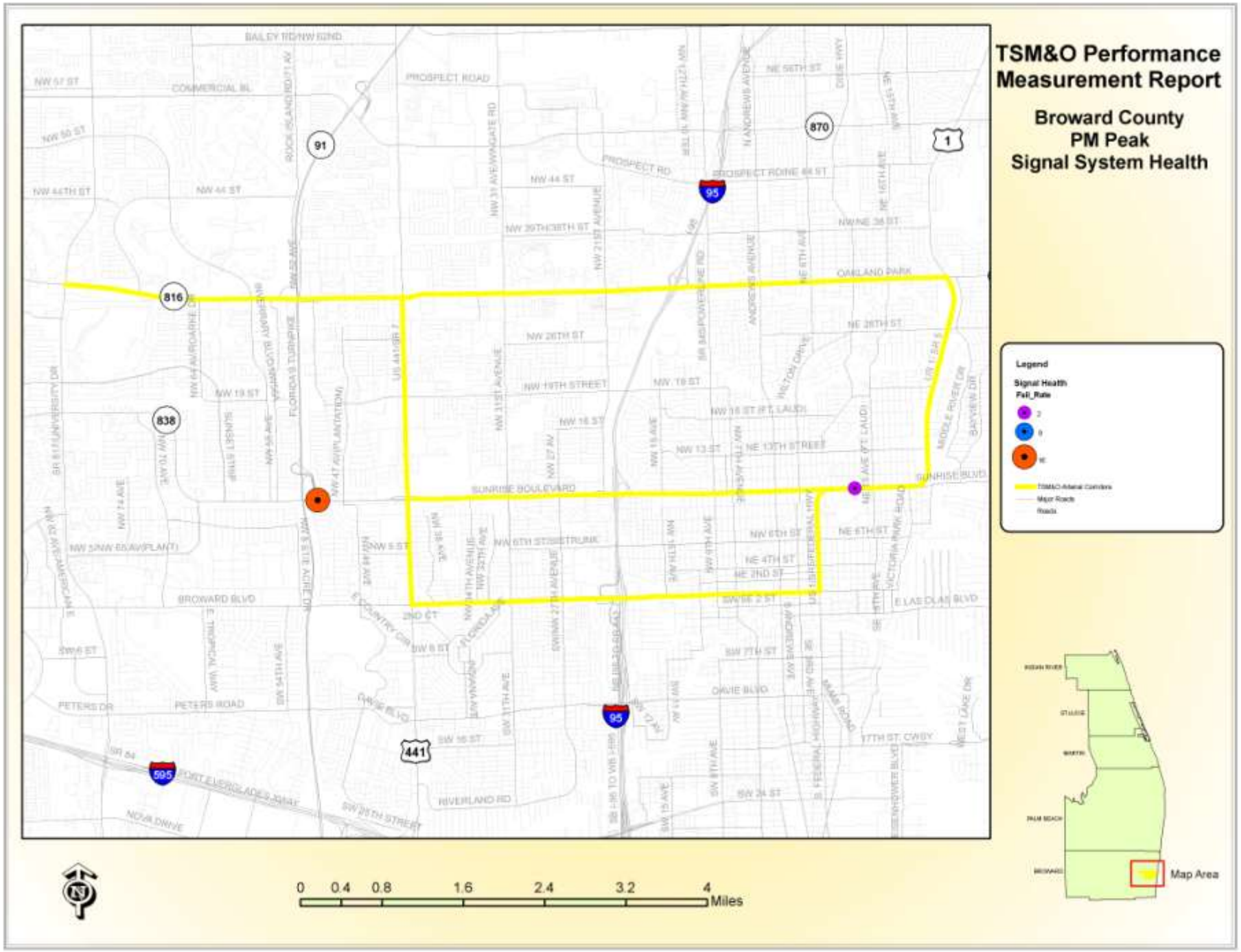
ID	Corridor	AM Peak			Midday Peak			PM Peak		
		Number of Pre-emptions	Number of Failures	Change from Last Quarter	Number of Pre-emptions	Number of Failures	Change from Last Quarter	Number of Pre-emptions	Number of Failures	Change from Last Quarter
1	Oakland Park Blvd (West)	55	8	N/A	98	9	N/A	94	10	N/A
2	Oakland Park Blvd (East)			N/A			N/A			N/A
3	Sunrise Blvd	18	9	N/A	46	18	N/A	45	20	N/A
4	Broward Blvd	10	4	N/A	48	21	N/A	36	0	N/A
5	SR-7	12	0	N/A	8	0	N/A	22	0	N/A
6	US-1	0	0	N/A	0	0	N/A	0	0	N/A
Total		**21**	**95**	**N/A**	**48**	**200**	**N/A**	**30**	**197**	**N/A**

Figure 10. Signal System Failures for the TSM&O Network




TSM&O Performance Measurement Report
Broward County
AM Peak
Signal System Health
Legend
Signal Health
Fail Rate
1
7
TSM&O Arterial Corridors
Major Roads
Roads
Map Area
0 0.4 0.8 1.6 2.4 3.2 4
Miles


TSM&O Performance Measurement Report
Broward County
Midday Peak
Signal System Health
Legend
Signal Health
Fail Rate
3
8
15
TSM&O Arterial Corridors
Major Roads
Roads
Map Area
0 0.4 0.8 1.6 2.4 3.2 4
Miles


TSM&O Performance Measurement Report
Broward County
PM Peak
Signal System Health
Legend
Signal Health
Fail_Rate
TSM&O Arterial Corridors
Major Roads
Roads
Map Area
0 0.4 0.8 1.6 2.4 3.2 4
Miles
BAILEY RD/NW 62ND
PROSPECT ROAD
PROSPECT RD
OAKLAND PARK
SUNRISE BOULEVARD
BROWARD BLVD
PETERS ROAD
PETERS DR
DAVIE BLVD
RIVERLAND RD
NOVA DRIVE
SW 25TH STREET
E LAS OLAS BLVD
SUNRISE BLVD
91
95
816
838
441
595
870
1

Work Zone Characteristics

DEFINITION

Work zone characteristics describe the planned construction projects and other maintenance activities occurring on the TSM&O network during the data collection time period.

PURPOSE

Work zone characteristics is included as a performance measure to help identify possible causes of delay on arterials.

OBJECTIVE

Reduce the impact of work zones on traffic operations on critical arterial segments in the TSM&O network.

METHODOLOGY

FDOT is aware of major construction projects, and travel time volunteers also observe maintenance activities while they are conducting travel time runs.

RESULTS & TRENDS

Table 9 summarizes the work zone activities that occurred on the TSM&O network during the data collection period. There were no planned construction projects occurring on the network; however, Broward County did perform maintenance on street lights along Broward Boulevard.

Table 9. Work Zone Activities on the TSM&O Network

ID	Corridor	Location	Date	Event Description	Lanes Impacted	Event Start Time (hr:min)	Event End Time (hr:min)	Duration of Event (hr:min)
4	Broward Blvd	West of NW 15th Avenue	10/15/09	Broward County working on street lights	N/A	11:30	13:30	2:00

Air Quality

DEFINITION

This measure describes the quality of the air at a given location on the TSM&O network.

PURPOSE

Air quality is a measure of the effectiveness of TSM&O strategies in reducing greenhouse gas emissions.

OBJECTIVE

Reduce greenhouse gas emissions on critical arterial segments in the TSM&O network.

METHODOLOGY

Air quality data is obtained from Broward County's Pollution Prevention, Remediation and Air Quality Division, which manages several air quality measurement stations throughout the county, as shown in Figure 11. For purposes of TSM&O performance reporting, air quality data is obtained for Station 28, which is located on Sunrise Boulevard within the limits of the Broward County TSM&O network. This station collects Carbon Monoxide (CO), Sulfur Dioxide (SO_2), and Particulate Matter (PM-10). Broward County currently measures air quality every 6 days at Station 28, but will eventually implement continuous data collection.

Air quality data was obtained from Station 28 for the data collection period, October 14-15, 2009.

RESULTS & TRENDS

Table 10 summarizes air quality results for the TSM&O network during the data collection period, along with the change compared to last quarter. The maximum allowable guidelines for emissions are as follows:

- CO Max Allowed: 9 ppm
- SO_2 Max Allowed: 0.14.ppm
- PM-10 Max Allowed: 150 $\mu g/m^3$

CO, SO_2, and PM-10 emissions for the Broward County TSM&O network were all within the maximum allowable guidelines.

Table 10. Air Quality for the TSM&O Network

	Carbon Monoxide (CO) Ppm		Sulfur Dioxide (SO_2) ppm		Particulate Matter (PM-10) $\mu g/m^3$	
	This Quarter	**Change from Last Quarter**	**This Quarter**	**Change from Last Quarter**	**This Quarter**	**Change from Last Quarter**
Minimum Observed	0.3	N/A	0	N/A	9.4	N/A
Mean Observed	0.5	N/A	0.002	N/A	11.6	N/A
Maximum Observed	1	N/A	0.032	N/A	14	N/A
Maximum Allowed	**9**	**-**	**0.14**	**-**	**150**	**-**

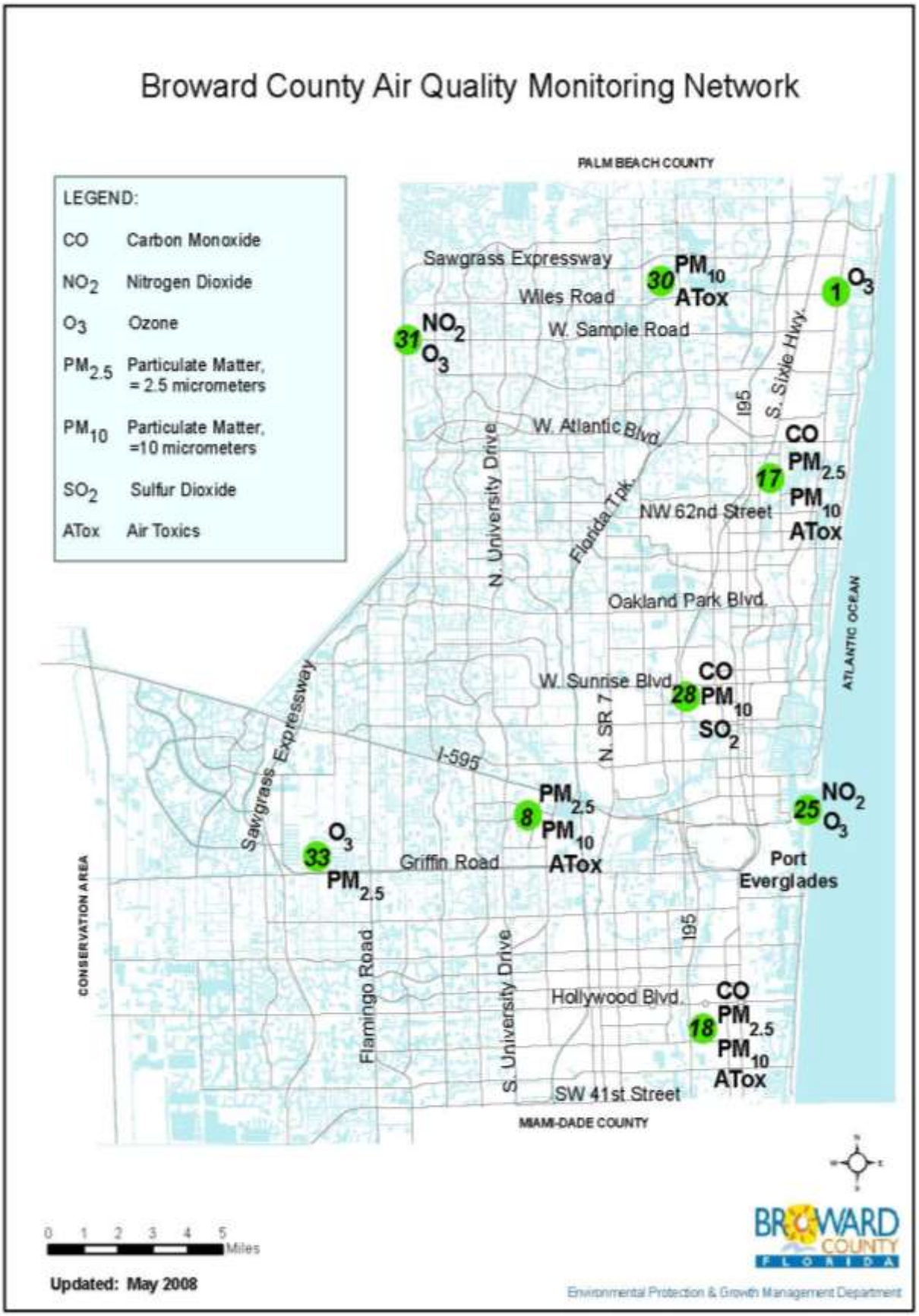


Figure 11. Broward County Air Quality Monitoring Site Locations

Resources Spent

DEFINITION

This measure describes the additional funding required to support data collection for quarterly TSM&O performance measure reporting for Broward County, including labor, equipment, annual expenditures, etc. This measure excludes data that is currently collected/reported by other agencies (e.g., transit schedule adherence, transit passenger count data for person throughput, traffic signal system health, air quality, and work zone characteristics), or that is collected by travel time run volunteers (e.g., travel time index, arterial travel time delay, number of incidents, and incident duration).

PURPOSE

Resources spent tracks the additional funding required to support data collection for quarterly TSM&O performance reporting.

OBJECTIVE

Minimize resources spent to support data collection for quarterly TSM&O performance reporting.

METHODOLOGY

For the October data collection period, the Department reported on the additional funding required to collect traffic volume data at 20 PTMS locations for purposes of calculating vehicle throughput. Resources spent is calculated as the average cost for data collection per site multiplied by the number of sites, as shown in the following equation:

Resources Spent = Average Cost per Site for Data Collection $\times$ Number of PTMS Locations

RESULTS & TRENDS

Table 11 summarizes the Resources Spent to collect the data for Vehicle Throughput. The total cost was $7,119.87. This amount is unchanged compared to last quarter.

Table 11. Resources Spent for the TSM&O Program

	Average Cost per Site for Data Collection	Number of PTMS Locations	Total Cost
Broward County	$355.99	20	$7,119.87